Abstracts of the Talks (Wednesday May 22, 2024)

9:00 – 10:00 **Katya Krupchyk**, University of California, Irvine

Title: "Inverse problems for elliptic operators on Riemannian manifolds."

Abstract: We discuss recent progress on inverse problems for elliptic operators in the setting of Riemannian manifolds. The first part of the talk concerns the fractional anisotropic Calderon problem on closed Riemannian manifolds. We demonstrate that the knowledge of the local source-to-solution map for the fractional Laplacian, given on an arbitrary small open nonempty a priori known subset of a smooth closed Riemannian manifold, determines the Riemannian manifold up to an isometry. This can be viewed as a nonlocal analog of the anisotropic Calderon problem in the setting of closed Riemannian manifolds, which remains wide open in dimensions three and higher. The second part of the talk deals with inverse boundary problems for semilinear Schrodinger equations on smooth compact Riemannian manifolds with boundary, at a large fixed frequency. We demonstrate that certain classes of cubic nonlinearities are uniquely determined from the knowledge of the nonlinear Dirichlet-to-Neumann map at a large fixed frequency on quite general Riemannian manifolds. In particular, in contrast to the previous results available, here the manifolds need not satisfy any product structure, may have trapped geodesics, and the geodesic ray transform need not be injective. Only a mild assumption about the geometry of intersecting geodesics is required. The talk is based on joint work with Ali Feizmohammadi, Tuhin Ghosh, and Gunther Uhlmann, as well as on joint work with Shiqi Ma, Suman Kumar Sahoo, Mikko Salo, and Simon St-Amant.

10:30 – 11:30 **Shixu Meng**, Virginia Tech

Title: "A low rank method for inverse scattering."

Abstract: Inverse problems play important roles in various applications, including target identification, non-destructive testing, and parameter estimation. Particularly challenging is the inverse scattering problem in inhomogeneous media, which aims to estimate unknowns based on available measurement data. Given its inherently ill-posed nature, our aim is to address this challenge by developing a low rank method. In the Born or linearized case, we solve the unknown in a low-dimensional space comprising disk prolate spheroidal wave functions, which are computed efficiently via a Sturm-Liouville problem. The low rank method leads to increasing stability and dimensionality reduction, as demonstrated by numerical examples with potentially noisy and large-scale measurement data. We establish a stability estimate by leveraging the interplay between a Fourier integral operator and a Sturm-Liouville differential operator. Additionally, motivated by the parameter estimation result of this low rank method, we explore the potential of parameter estimation using the linear sampling method for both the Born case and the fully nonlinear case. In particular, we show that the linear sampling indicator converges, depending on the problem formulation, to either a linear or nonlinear transformation of the unknown.

11:30 – 12:30 **Peter Monk**, University of Delaware

Title: "Sampling methods applied to multi-frequency real data."

Abstract: We consider the use of sampling type methods when applied to measured multi-frequency data. The data, mainly from the Fresnel Institute in France, is not multi-static, and we discuss the problem of data completion. We also consider the use of the serial, parallel and product indicators to combine multi-frequency data. The results focus on the classical linear sampling method, but we also will discuss issues related to using other sampling methods on real data. The work is joint with Prof Virginia Selgas and Dr Manuel Pena at the University of Oviedo in Spain.